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Recommendations for the Development of Web Interfaces on Tablets/iPads with Emphasis on Elderly Users

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Abstract

The use of Internet services is part of the daily life of people and should be easy to understand, presenting no technological barriers regardless of the type of user or of the equipment being used. Elderly users play a prominent role in the increased use of online tools, not only on personal computers but also in the use of new technologies such as tablets. This exploratory study, with ten participants, aims at analyzing interactions made by elderly and young users when accessing Gmail on the web version of the iPad and comparing it to that of young users in order to assess similarities and differences. Focus was placed on academic issues related to interfacing by elderly users, whereby some points were still relevant and others criticized for not being aligned with the technology of tablets and the form of gestural interaction. As a result, a list of recommendations was compiled for the development of web interfaces for tablets/iPads with emphasis on elderly users.

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Keywords: elderly, usability; tablet; interface; ipad

1. Introduction

Technology and the Internet are part of the daily lives of people and help in the social integration of senior citizens by stimulating cognition and communication between individuals and groups[20]. The group of elderly web users grows increasingly driven by factors such as: the rate of aging of society, more active social participation, late retirement and the growing percentage of people who start to use the Internet after 60 years of age[19]. Nevertheless, sites and applications still remain inaccessible due to usability issues when viewed on mobile devices[26].

This research aims at evaluating Gmail web browsing on iPads for young and elderly users, using a specific protocol for the evaluation of usability tests, in order to analyze similarities and differences in relation to the applied

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gestures, recognition of UI elements and possible problems of accessibility or usability. As a result, a list of recommendations has been compiled to support the development of web interfaces for iPad with emphasis on elderly users.

2. Referential

2.1. Senior Citizens

In some countries, the start of the third age is signaled by entry into the 50 years and over age bracket[32], though in Brazil this starts at the age of 60, where individuals are protected by laws such as the Statute of the Elderly[2] brought about due to numerous cases of physical, emotional and social disrespect. Senior citizens in Brazil represent a group of about 12% of the entire population and make up a very heterogeneous group ranging between 60 and 100 years of age[18]. With advancing age, the motor, physical and cognitive aspects of the elderly are affected[31]. Such problems, together with early retirement, contribute to senior citizens suffering from prejudice and isolation both in traditional and in digital society[3]. When elderly people are able to integrate back into society, it minimizes the negative effects of aging, increases self-esteem and the stimulus to acquire new knowledge[18].

2.2. Experience with the Internet and Tablets

Some senior citizens avoid using computers out of fear, lack of knowledge and inadequate equipment[13,32]. The Brazilian Institute of Public Opinion and Statistics - IBOPE, reported that 52% of people between 65 and 75 years of age still have problems regarding the use of computers[19]. In early 2013, elderly Internet users in Brazil accounted for only 1.95% of all Brazilian users and the average time spent monthly by them on the Internet is approximately 44 hours[19].

But the amount of hours spent is not always the factor that indicates which user is more experienced than the other[7]. Experience on the Internet for older users is influenced by the relationship between the acquired knowledge, collaborative learning and patterns of web browsing[6]. Older people have less experience in web collaboration, often due to the absence not only of a computer but also of the Internet during their working years[13].

Despite the growing number of elderly users accessing the Internet[19], many factors related to the design of a system, such as usability, accessibility and user experience, are still being studied in the literature. The tablet has become a device of mass consumption among elderly people, as it is utilized in various everyday situations reflecting the importance of making it practical and accessible to users[25].

2.3. Related Research Studies

An exploratory research on the interactions of elderly users with iPads[21] concluded that the tablet is an ideal device for this type of audience and one week of use was sufficient to enhance learning. By the end of 2013, only this research listed four web development recommendations with emphasis on elderly users and tablet.

The Nielsen Norman Group applied usability tests using various tablets in order to analyze the interactions of users between 24 and 51 years of age[26]. The study cited problems with interaction with data entry, lack of feedback and recommends prioritizing features and relevant content.

The concept of Mobile First makes recommendations on the organization of information taking into account the experience and user behavior with regard to the universe of mobility. Best practices on mobile first avoid wrong actions and focus on the influence of fingers to perform tasks on mobile devices[38].

Tablets have a preconfigured system that meets the simplest features, such as web browsing[23]. Based on this information, Li and colleagues have created a browser focused on elderly users, simplifying the manner in which it is used and making it more enjoyable.

A research study assessed 42 gestures counting those of old and young users, but did not point out which would be the most suitable for senior users to interact with touch interfaces[33,35].

3. Research Method

The research, exploratory in nature, was performed by means of a case study with two units of analysis, in addition to observation techniques applied in a usability test aimed at just web browsing. These tests were performed on the researcher's iPad due to the need to use a paid application for screen capture already associated with a registered profile. The method is comprised of seven stages: (a) Definition of the target audience; (b) Definition of the tablet model and operating system; (c) site selection as an object of study; (d) Selection of a protocol for usability tests; (e) Elaboration of the case study; (f) Analysis of the results; (g) Elaboration of recommendations.

3.1. Definition of target audience

The difficulty of finding data as to how elderly people interact with iPads, especially those more advanced in years in the Brazilian society, and the comparison of such a group with younger users, have become key points in this research work. It was decided to focus on senior citizens outside of the Labor Force Participation Rate - LFPR (15-69 years of age), i.e., those over the age of 70, retired and who did not work at computer-related jobs. The comparison with a younger group, one that did not exercise activities related to information technology, composed of individuals between 25 and 44 years of age, allowed the representation of the two intermediate younger bands of Brazilian Institute of Geography and Statistics (IBGE)[17].

3.2. Definition of the tablet model and operational system

The amount of traffic generated on the Internet by non-traditional devices, *i.e.*, tablets, mobile phones and game consoles has increased considerably[9], being the iPad the best selling device[8], in addition to originating the greatest number of Internet accesses on tablets in Brazil and the world over[10,11]. Thus, the chosen operating system is iOS 6.0 and the Internet browser is Safari for being original to the equipment.

3.3. Site selection as the object of the study

In Brazil, 78% of Internet users utilize e-mail as their main communication activity[4] and Gmail correspond to 41% of all email services accessed, totaling nine million users[12].

3.4. Choosing a protocol for usability tests

We adopted a protocol designed by Thea Van Der Geest[15] named "*Conducting Usability Studies with Users Who Are Elderly or Have Disabilities*" and based on current good market usability practices. The protocol prioritizes the profile of elderly users in usability studies in site interfaces and was developed for the Dutch National Accessibility Bartimeus Foundation.

3.5. Elaboration of the case study

A case study, conducted with five young users and five elderly users, was set up with seven stages encompassing the collection of information, data analysis, and the final product of the research study. The case study will be detailed in Section 4.

3.6. Analysis of results

The subjective evaluation questionnaire and the material from the researcher's notes were interpreted in order to create an inventory of problems and recommendations for improvement. A comparison was also made with other academic research studies conducted with elderly people in order to assess the participant's qualitative opinion with regard to interface issues and user experience[32,13,5,24,39]. The results of the analysis can be found in Section 5.

3.7. Elaboration of recommendations

After the tests, participants were asked about suggestions for improvements to Gmail based on problems encountered during testing. They cited items to be explored in order not only to help user experience on the site but also to help compile a set of recommendations. These recommendations are described in Section 6.

4. Case Study

4.1. Stage 1: Definition of units of analysis

The case study had only one context of use containing two units of analysis: a group of elderly participants and a group of young participants. The groups performed the same tasks through a usability test and evaluated the quality, user experience and level of satisfaction of the service under analysis.

4.2. Stage 2: Selection of participants for the study

The requirements for participants was to have an active email account in Gmail, have skill and experience in the use of the Internet, have had an iPad for at least two months[27], use it as often as at least twice a week and not have training or work associated with computers. The recommendation of the adopted protocol was followed in recruiting elderly participants through referrals from friends and relatives[15].

The research study was published on Facebook, released in a mailing list and among employees of a company in the government sector. We selected an elderly volunteer and a young man to carry out the pilot tests, as well as the recruitment of five users for each group. The recommendation to use five users is linked to Nielsen's research[29] where these five participants are able to detect up to 85% of usability problems, as long as they belong to the same group, and make use of a site in similar conditions.

4.3. Stage 3: Definition of most used features in Gmail

We decided to create a questionnaire to glean information about Gmail best features. The questionnaire was published in Google Docs and released on a mailing list for fifteen days in early March 2013. A total of 44 respondents answered the inquiry and the main highlighted features were: send messages, search for words, apply labels, mark a message as unread, archive messages, undo an action and highlight a message as favorite.

4.4. Stage 4: Definition of tasks for the usability test

A list of ten tasks was created to be applied on the usability test based on the answers to the questionnaire explained in the above item. Each task was applied in a real usage scenario as follows: T1: Create and send a message; T2: Forward a message; T3: Mark a message as spam; T4: Apply a label and archive a message; T5: Find a previously archived message and delete it; T6: Search for a name or email; T7: Mark a message as unread; T8: Mark a message as favorite; T9: Delete a message and undo this action; T10: Check for new messages.

4.5. Stage 5: Pilot test

Two pilot tests were performed, one with an elderly participant and one with a young user using the researcher's iPad and the UX Recorder application for audio recording and gestures applied to the interface. We used a mobile iPhone as a second audio recording option in case the application failed. We decided to simplify some tasks, turn the text more objective for the elderly and set to 30 minutes the usability session, averaging 3 minutes per task.

4.6. Stage 6: Execution of tasks for the test

The implementation of the usability tests took place between May and June 2013. The residence of each participant was chosen not to cause discomfort in their having to move around. This was followed by implementing the guidelines of the chosen protocol[15] and best practices on usability tests[16,22].

4.7. Stage 7: Definition of metrics for subjective assessment

A subjective assessment questionnaire was adopted comprising of 17 questions and a likert scale to evaluate the degree of user satisfaction.

4.8. Profile of participants

Based on the requirements for research participation, a survey questionnaire to assess the profile of young users (Y) and elderly users (E) was used as shown in Table 1.

Table 1. User profile.

#	User	Gender	Age	Occupation
1	Y1	Female	31	Accountant
2	Y2	Female	38	Lawyer
3	Y3	Male	39	Illustrator
4	Y4	Female	28	Engineer
5	Y5	Male	25	Sales Administrator
6	E1	Male	71	Bank Manager (retired)
7	E2	Female	70	Teacher (retired)
8	E3	Male	71	Lawyer (retired)
9	E4	Female	76	Writer (retired)
10	E5	Male	72	Accountant (retired)

Some of the elderly participants said they had started using the Internet due to the encouragement of their children and grandchildren. Table 2 shows that only one elderly person (E2) had less than 8 years of experience on web browsing, using e-commerce, e-mailing, online videos, social networking, newspapers and games.

Table 2. User's Internet experience.

User	Y1	Y2	Y3	Y4	Y5	E1	E2	E3	E4	E5
Less than 8 years of usage							x			
More than 8 years of usage	x	x	x	x	x	x		x	x	x

According to Table 3, two young participants used the iPad every day of the week (Y2 and Y3) while four elderly participants (E1, E3, E4 and E5) maintained this same frequency.

Table 3. Ipad's usage per week.

User	Y1	Y2	Y3	Y4	Y5	E1	E2	E3	E4	E5
2 days per week	x			x			x			
3 to 5 days per week					x					
7 days per week		x	x			x		x	x	x

4.9. Usability test

The users were enthusiastic about the usability test, which made for more relaxed and casual contacts. All senior users had a family member present to accompany the test. Only three of the elderly participants took a little longer than 30 minutes to complete the test. The researcher adopted a stance of not interrupting users, since it was clear that they were engaged in the tasks and thus should not be de-motivated. All volunteers were instructed about simultaneous verbalization, especially the elderly group, but most of this group preferred verbalizing subsequent to the test.

Annotations related to time, errors and completion of tasks were made during the test. Any action, quotes or comments made by users were taken down by the researcher on this material.

5. Analysis of Results

Most of the tasks were completed by elderly people with assistance and some were not. Table 4 shows the amount of completed tasks, offered help and not finalized during the test. Only 52% of the tasks were concluded by the elderly group without help, while the other group concluded 96%.

Table 4. List of tasks concluded (Y), concluded with help (H) and not concluded (N).

User	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Y1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Y2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Y3	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Y4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Y5	Y	Y	Y	Y	Y	Y	H	Y	Y	Y
E1	Y	N	H	H	Y	H	Y	Y	H	Y
E2	N	Y	Y	H	N	H	Y	Y	H	Y
E3	Y	Y	H	N	N	H	Y	H	N	Y
E4	H	Y	Y	H	Y	Y	Y	N	N	Y
E5	Y	Y	Y	Y	Y	H	Y	Y	Y	Y

5.1. Analysis of task 1 (creating and sending a message)

Two young participants later recognized the “new message” icon on iPad. In the elderly group, one of them not even able to complete the task, and three others finished overtime. Volunteer E2 declared had never created a new message and just answered those that were in her inbox. They all mentioned that the “pencil” icon is not clear enough to represent the function, requiring a caption for better understanding. Typing was performed faster by young people, who used both hands, unlike the elderly volunteers, who were all reported using only one hand out of habit, they said, as in handwriting.

5.2. Analysis of task 2 (forwarding a message)

The icon for the forward-a-message option was perceived and used by four young participants but by only one senior volunteer. The other participants did not identify this icon and used the "Forward" big button at the end of the e-mail body as it was easier due to the label and to its size in the interface.

5.3. Analysis of task 3 (marking a message as spam)

The access icons to the Gmail features panel and "Report Spam" were recognized by three young and three elderly volunteers. The other users had difficulty and all said the icon was not intuitive.

5.4. Analysis of task 4 (apply a label and archive a message)

The young people completed the task more quickly by tapping the unlabeled icons, differently from the elderly participants, who sought information within the function panel, as they realized the icons had captions. The entire elderly group declared that when there is a description of the icon, it is easier to understand and complete a goal.

5.5. Analysis of task 5 (searching for a archived message and deleting it)

Three elderly participants were slow to find the access icon for folders and again justified the lack of captions as the problem. Two elderly volunteers (E2 and E3) did not complete the task, because they found differences between the iPad version and the desktop version. The E2 user also did not know not recognize the trash icon.

5.6. Analysis of task 6 (searching for a name or e-mail)

The search box was hardly evident, poorly positioned, not always visible, besides being gray in color, so leading to believe it was disabled. The Y1 volunteer could not find it and so ended up using the Google search field. Volunteer E2 complained that the search result changed whenever he typed into the search field, hindering his understanding of the operation. Elderly volunteers E3 and E4 did not know about the existence of the field.

5.7. Analysis of task 7 (Marking a message as unread)

The operation of marking a message "Unread" was considered easy because it had a caption on the icon. Among the elderly users, only one did not complete the task; the others said they recognized both the icon and realized that an unread message is marked in bold.

5.8. Analysis of task 8 (Marking a message as favorite)

The gray color used on the icon confused volunteer Y4, who thought it was inactive and so did not use it. Greater difficulty was recorded in the elderly group as all made mistakes. E1 participant commented that the icon was not readily visible since it was positioned on a white background.

5.9. Analysis of task 9 (deleting a message and then undoing the operation)

Polluted information interface was mentioned by eight users as one of the reasons that hindered the visualization of the temporary signs, even more so because it was positioned in a peripheral area of the interface. It was evident that it was not clearly and a visual feedback can be applied to give it more visibility, even in conjunction with haptic and audio feedback.

5.10. Analysis of task 10 (checking for new messages)

Young users performed the task by means of a "swipe down" gesture on the left-side panel of the Gmail interface, while elder users touched the "inbox" label as they were unaware of the existence of the gesture. It was clear that young users were accustomed to the gesture, as many used applications that require constant updates.

5.11. Analysis according to the time of execution of the tasks

A metric used in quantitative usability analysis to compare user efficiency is the time to complete a task[30] where a difference of 43% of time spent between elderly and young users came to light. The predominance of gray tones and the lack of prominence of the messages in the interface have been criticized by all participants, especially the elderly, who pointed these out as the main reasons for delay, increasing the task execution time.

The average test time for young users was approximately 18 minutes while the average among elderly users was 30 minutes, representing a 67% difference. However, when comparing the slowest elderly participant to the fastest elderly participant, there was a gap of almost 15 minutes, which demonstrates the difficulty in standardizing the profile of this user type[7]. Nevertheless, the elderly user who completed the test the fastest made almost the same time as the younger user, confronting the 43% rate reported in the latest study conducted by Nielsen. This user was the most experienced of the elderly group, indicating that the time metric may vary in some situations, even to the point of equating the efficiency of the elderly user to that of the young user.

5.12. Analysis according to the number of errors during tasks

The occurrence of errors per task was considered low in the group of young people in relation to the elderly group. Considered a usability metric[30], the error rate when performing tasks can reach a difference of up to 120% between young and old. However, in this study, the error difference was higher. It was seen that during the initial tasks, the errors of elderly participants were more evident due to unrecognized icons and problems in typing. Elderly participants explored the interface more because they knew little about some of the features, as was the case in task 6, generating an error rate four times higher when compared to young users.

The error log was not considered an ideal metric to address both efficiency and effectiveness, as the operation of the interface caused many touches on elements and functions that were not needed at a particular time, but that somehow helped users learn paths by heart and remember features that would be required for future tasks. Elderly users pointed out that errors are a part of learning and declared at the end of the test that they were more confident, because they learned new things.

5.13. Analysis of the subjective assessment of users

The subjective evaluation proposed by Nielsen[28], from participants' answers to a questionnaire with a 10 points rating scale, was compiled from the answers participants gave. Contrasting with some academic studies[5,13,24] scrolling was considered easy by elderly users. Despite previous studies having analyzed the interaction with the mouse, the use of the finger is faster and covers a larger touch area.

The font size had been discussed in previous works[13,14,37], but at the time they were taking into account old monitors and lower resolution compared to iPad's high resolution. This helped in not requiring zoom features.

Both groups reported problems when touching nearby buttons and icons by mistake, reinforcing the spacing problem on mobile devices cited in recent studies[26,38]. The difference in interface between desktop and mobile has been criticized by all users. They suggested maintain consistency of elements in order not to affect the continuity of use from one device to the other.

Elderly participants complained that icons generated doubts and were therefore misleading. The redesign of these elements and the use of captions can improve user experience. Senior citizens also said they had trouble recognizing elements with little contrast, light colors, grayscale, and objects in peripheral areas of vision, confirming what had already been mentioned in other studies[34,13,32,36].

Young people were more familiar with the structure of the site, interacting with Gmail navigation itself. Elderly users did not notice this type of navigation and always preferred to use the "back" button as a safe way to navigate and cancel an action. They said that button refers to a recent sequential action[1,13].

6. Recommendations For Web Interface Development On Ipad Specific for Elderly Users

Based on participants' suggestions, data obtained and analyzed in this study, we designed 16 recommendations:

- Provide easy-to-understand icons followed by caption or description;
- Develop buttons with labels instead of images;
- Maintain minimum spacing of 44 pixels between interface elements;
- Keep gestures simple to perform basic commands of the system;
- Avoid creating multiple gestures that combine more than two fingers and require the use of both hands;
- Show visual, audible or haptic feedback when users do touch configuration;
- Keep the same positioning of the elements in the interface and in their respective operations;
- Outline the main features of the system;
- Display a help panel and tips about the features in the first user access;
- Guide the user by means of messages in clear, objective and educational language;
- Increase the exposure time of temporary posts and position them in the middle of the interface;
- Avoid instant features that change with each new interaction such as filters and auto-completion;
- Use easy to read fonts and colors with contrast;
- Maintain the focus of the system on the current user action without displaying secondary functions;
- Maintain a "return" function apparent on the interface;
- Maintain link underlined.

7. Conclusion

This research, of a qualitative and exploratory nature, is aimed at analyzing the interactions of elderly users through usability tests on iPads using an e-mail service. It was decided to compare such interactions with those of young users, in search of similarities and differences in order to develop a list of recommendations for sites on iPad.

We were able to confirm and question some factors that influence in the interaction of elderly people with web interfaces, suggesting improvements that attend to touch screen settings. It was found that senior people take longer than young people to perform tasks, though this does not mean that this is true for everyone. One of the elderly individuals observed had a great deal of knowledge about the Internet and use of iPad, getting almost the same score as that of the youngest user in this research. Age, ability, aptitude and attitude influence in elderly user profiles, besides experience and frequency of use of a product. These factors are important in order to break the bias in thinking that elderly individuals are slow and less productive due to their age.

One of the biggest problems found was the use of icons, impairing the interpretation of functions and increasing the incidence of errors. When there is some sort of caption, icons are clearly understood, as well as the buttons with labels, aiding in the reading and in touch screen actions.

Interfaces must maintain the same layout and positioning of elements. Elderly participants had no problem interacting with scrolls in the touch interface; in addition, they also mentioned that they had no problem reading texts without the need to zoom. It was noted that gestures were more diverse for young people due, primarily, to the use of apps and to social networks. According to the elderly users, gestures can be easily managed if kept simple.

The use of gray tones and colors with low contrast were criticized. The positioning of elements outside one's line of sight impairs the visualization of information, especially in the case of elderly people, who also have difficulty perceiving temporary notices on the interface. The same occur on auto-complete functions. They confuse elderly users who to understand how it operates and perceive secondary actions. The use of the "back" button is still important due to the lack of function recognition and problems with system’s deep navigation.

We hope that the result of this research will contribute to the development of accessible interfaces with good usability, compelling designers, developers and managers to take the experiences of elderly users into account, thus improving access to information on the Internet, web services and mobile apps.

Future Studies

A comparative study with other elderly age groups and more users with different Internet experience level are important in order to promote a wider range of solutions. We started a prototype based on some suggestions and a new usability test will be necessary, including other tablet models.

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